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Amendment of Soil with Siam Weed (*Chromolaena odorata* King and Robinson) and Sunn Hemp (*Crotalaria juncea* L.) for Control of the Root-lesion Nematode, *Pratylenchus brachyurus* in Selected Cereals

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ABSTRACT
The effect of siam weed and sunn hemp applied as organic amendments on population and damage of the root lesion nematode, *Pratylenchus brachyurus*, infecting maize and sorghum and on yield of root lesion nematode-infested maize and sorghum were investigated. A set of field trials were conducted in *P. brachyurus* infested fields for two consecutive years. Six week-old siam weed and sunn hemp seedlings were incorporated separately in maize and sorghum fields at the rates of 10 plants per plot (22,220 plants/ha) and 20 plants per plot (44,440 plants/ha). Data were collected on grain yield at harvest; and on soil chemical properties, and soil nematode population at the beginning and end of the study. The results showed that six-week old plants of siam weed and sunn hemp incorporated into the soil at 20 plants/plot significantly ($P \leq 0.05$) reduced the population of *P. brachyurus* in soil and increased grain yield of maize and sorghum in comparison to 10 plants/plot and the control in the two field trials. However, sunn hemp significantly increased the yields of the crops and reduced the soil population of the nematode more than siam weed at both rates. The results of this study suggest that six-week old siam weed and sunn hemp plants incorporated in *P. brachyurus*-infested soil have benefits for management of *P. brachyurus* and reducing nematode damage on yield of maize and sorghum.

Keywords: maize, *Pratylenchus brachyurus*, siam weed, sorghum, sunn hemp

INTRODUCTION

Root-lesion nematodes *Pratylenchus* spp. are among the most important plant-parasitic nematodes encountered in both the tropical and subtropical regions of the world (Castillo and Vovlas, 2007). In terms of their economic impacts on crops, they rank second only to root-knot and cyst nematodes (Sasser and Freckman, 1987). This is partly due to their wide host range and distribution in several regions of the world. They attack and cause significant yield losses on a host of cultivated crops including maize and sorghum (Castillo and Vovlas, 2007). Significant yield losses of maize due to attack by *Pratylenchus* spp. Including, *P. brachyurus*, *P. hexincisus*, *P. penetrans*, *P. scribneri* and *P.*

zeae have been reported (Windham, 1998). *P. brachyurus and P. zea* have been implicated in maize and sorghum respectively in Nigeria (Egunjobi and Larinde, 1975; Onifade and Egunjobi, 1996). Plants infected by the nematodes are characterized with stunted growth and necrotic lesions on roots system. About 10% yield losses due to the nematode pest have been reported (Windham, 1998). The nematode can also form disease complexes with other phyto-pathogens such as fungi and bacteria thereby, increasing yield losses (Castro and Vovlas, 2006; Ravichandra, 2013), hence control becomes relevant.

Chemical nematicides have been shown to be effective in suppressing nematode populations in both field and screenhouse trials (Sikora and Fernandez, 2005; Amulu and Adekunle, 2015). However, their use have been associated with many problems including limited availability in many developing countries, potentials for polluting the environment, health hazards and high costs (Izuogu and Oyedunmade, 2009). Based on these, there has been increased interest in the development of alternatives to use of synthetic nematicides in nematode control (Siji, *et al*., 2010) including the use of organic amendments of plant origins, and this has been found to hold promise (Adekunle, 2011). Significant reductions in soil populations of *P. brachyurus* and yield increases of maize, in Nigeria have been reported following the incorporation of plant residues and farmyard manure in soil infested with the nematode (Egunjobi and Larinde, 1975).

Siam weed and sunn hemp are among the most common plants growing as weeds in the tropics. Several workers have consistently reported that these plants are effective in suppressing nematode populations when used as plant extracts, organic amendments and recently cover crops.

(Adekunle and Fawole, 2003; Adekunle, 2011). The desirable properties of these plants as cover crops include their ability to grow rapidly, poor host status to several nematode spp., including *P. brachyurus* (Charchar and Huang, 1981; Wang *et al*., 2002). They can also enhance both the chemical and physical properties of the soil (Rotar and Joy, 1983; Marshall, 2002). Root and leaf exudates from sunn hemp have been reported to contain allelopathic compounds known as monocrotaline and have been reported to be toxic to several species of nematodes (Wang et al., 2002). Siam weed, *Chromolaena odorata* is a vigorous growing plant and has been reported to posses insecticidal and bactericidal properties (Oyedunmade and Fatoki, 2000). The objective of this study was to investigate the effects of sunn hemp and siam weed as soil amendments on yield of selected cereals grown in *P. brachyurus*-infested soil.

MATERIALS AND METHODS

Experimental Sites

Two different experimental sites, 150 m apart, naturally infested with *Pratylenchus brachyurus* at the Teaching and Research Farm of Obafemi Awolowo University, Ile-Ife located at latitude 07º28´N and longitude 04º33´N at 244 m above sea level, in the tropical rain-forest of Nigeria were selected. The land was ploughed and harrowed in the early rainy season (April) of 2013 and 2014 for maize trial and in the late rainy season (August) of 2013 and 2014 for sorghum trial.

Cropping History and Rainfall Pattern of Experimental Sites

Experimental sites selected had been planted to maize continuously for ten years and the daily minimum and maximum rainfall for the period of conducting the maize trial was 0.00 mm and 44.10 mm respectively while the daily minimum and maximum rainfall during the period of conducting the sorghum trial was 0.00 mm and 67.40 mm respectively.

Source of seeds and planting of Siam weed and Sunn hemp.

Seeds of *P. brachyurus*-susceptible maize cultivars- TZ-B-ELD-CS and TZ-DMRESR and sorghum cultivars-SK5192 and CSR-01 were obtained from Institute of Agricultural Research and Training, (IAR&T), Moor Plantation, Ibadan. Seeds of siam weed (*Chromolaena odorata* cv. Eupatorium) and sunn hemp (*Crotalaria juncea* cv. Genjan) obtained from the International Institute of Tropical Agriculture (IITA), Ibadan, Nigeria. Top soil and river sand in the ratio 2:1 were thoroughly mixed, steam staerilized for four hours at 70°C in a soil sterilizer and was allowed to cool for 48 hours. The soil was filled into sixty 1-litre plastic pots and seeds of siam weed and sunn hemp were sown separately in the plastic pots containing sterilized soil. The seedlings were maintained for six weeks under screenhouse conditions.

Estimation of Nematode Population in field plots

Nematode population density and identity were determined at the beginning and termination of experiments. From each of the 40 plots, a bulk sample consisting of 20 cores (diameter 2 cm; depth 0-20 cm) was taken. Two hundred ml of each soil sub-sample from the bulk sample collected from each plot was placed in the inner sieve of a modified Baermann extraction tray arrangement (Whitehead and Hemming, 1965). The set-up remained undisturbed for 48 hours, after which the sieves were gently lifted off the tray. The nematode suspension was concentrated to about 10 ml by sieving out excess water using a 45 μm aperture size sieve. Nematodes in each suspension were killed by adding 10 ml of boiling water into 10 ml of the nematode suspension (Coyne et al., 2009) and fixed in 4% formaldehyde (Coyne et al., 2009). Nematodes were counted in a Doncaster counting dish under a stereomicroscope (25×). Individual nematodes from each sample were further identified under a light microscope (40× magnification) to genus level (Mai and Lyon, 1975). Percentage change in nematode population was calculated using the formula =

$$\frac{Pf - Pi}{Pi} \times \frac{100}{1}$$

Where Pi = initial nematode population density and Pf = final nematode population density.

Pre-planting and Post-planting Soil Analysis

Part of the soil sample from each plot was analyzed at the beginning of experiments and at crop harvest for pH, total nitrogen (N), available phosphorus (P) and exchangeable potassium (K) using standard methods. The soil samples were air dried and sieved through a 2-mm mesh sieve in order to get rid of large stones and root fragments before analysis. Soil pH was determined using a pH meter and a glass electrode in distilled water and in 0.01 M $CaCl_2$ solution, using a 1:2 (w / v) mix of soil: $CaCl_2$, as described by described by Thomas (1996). Total nitrogen concentrations were determined by the macro-kjeldahl method according to Bremner (1996) and available phosphorous (P) was extracted by the Bray-1 method, as described by Kuo (1996) and measured using a spectrometer. Exchangeable potassium (K) was extracted with 1.0 M ammonium acetate, pH 7.0 potassium was measured using a flame photometer.

Field Layout and Experimentation

Two separate but identical sets of trials were conducted on each of the two experimental sites from April to July 2013 and 2014 for the maize trial and from August to December 2013 and 2014 for the sorghum trial. In the maize trial the experimental field was divided into four blocks of 24.5 m by 2 m, each block was divided into ten 2.25 m by 2 m plots (giving a total of 40 plots). There was a space of 1 m between blocks and 0.5

m between plots. The experiment was laid out as randomized complete block with 2 × 5 factorial arrangement in four replicates. In each replicate, the six-week old siam weed and sunn hemp plants were transplanted at the rates of 10 seedlings or 20 seedlings per plot in eight plots. Two plots that were not amended with siam weed or sunn hemp served as controls. The seedlings were allowed to grow for four weeks, after which they were incorporated into the soil in each plot using a hoe. Two weeks after incorporation of siam weed and sunn hemp seedlings, soil samples were collected from each plot for nematode and soil analyses.

Field trial of Siam weed and Sunn hemp soil amendments on Maize and Sorghum

Two weeks after incorporation of siam weed and sunn hemp seedlings into the soil, maize seeds were sown in each plot at the spacing of 75 × 25 cm. The treatments were two maize cultivars (TZ-B-ELD-CS and TZ-DMRESR) established in five treatment plots consisting of siam weed and sunn hemp at ten and twenty seedlings per plot each and an untreated control plot. Two seeds were sown per hole, and seedlings were thinned to one plant per stand two weeks after emergence giving a total of 20 plants per plot. The experiment was rain fed while manual weeding was carried out to keep the plots free of weeds. Inorganic fertilizer was not applied in the experimental plots. The study was terminated 90 days after planting.

At termination of the study, maize cobs were harvested from each plot, shelled and weighed. Maize grain weight was adjusted to 15% moisture content by drying. Soil samples were collected from each plot at the end of each experiment as described earlier for nematode and soil analyses. Similar procedure was used to establish siam weed- sunn hemp- sorghum trial in August 2013. Number of blocks and plots as well as size of plots were the same as described for the maize trial. In the sorghum experiment, seeds of the two cultivars of sorghum SK5192 and CSR-01 were sown at a spacing of 75 × 50 cm. Five seeds were sown per hole, and they were thinned to one plant per stand two weeks after emergence. The experiment lasted 120 days. Sorghum grains were harvested, threshed and weighed. Data collected was the same as for the maize trial. Soil samples were collected from each plot for nematode and soil analyses as previously described.

The field trials were repeated the following year (2014) at the same experimental site and with the same experimental design for maize and sorghum.

Statistical Analysis

All data obtained were subjected to analysis of variance (ANOVA) using SAS software (SAS, 2002) package. Treatment means were separated by Fisher's Least Significant Difference (LSD) test at $P \leq 0.05$. Means of nematode population and grain weight of maize and sorghum for two rates of siam weed and sunn hemp and control were compared for each cultivar of maize and sorghum for each trial.

RESULTS

Pratylenchus brachyurus population densities in both test and control plots were 415-490 J_2 / 200 ml of soil and 400–455 J_2 / 200 ml respectively in maize and sorghum plots before planting and were considered sufficient to initiate the infection of susceptible plants at the time of planting. Populations of *Pratylenchus brachyurus* increased significantly ($P \leq 0.05$) in control plots than population change in plots amended with siam weed or sunn hemp in the two cultivars of maize (Table 1). Sunn hemp reduced nematode population more significantly than siam weed. The highest percentage reduction in nematode population occurred in plots amended with 20 sunn hemp seedlings / plot (66.55%) and was significantly ($P \leq 0.05$) higher than the percentage nematode population reduction recorded in plots amended with sunn hemp at 10 seedlings / plot

(53.80%) and plots amended with 20 (46.26%) and 10 (41.03%) siam weed seedlings/plot. There were no significant ($P \leq 0.05$) differences between maize cultivars-TZ-B-ELD-CS and TZ-DMRESR in response to siam weed and sunn hemp amendments with respect to changes in nematode population. A similar trend was observed in the second trial (Table 1).

In sorghum experiment, amendment of soil with siam weed and sunn hemp significantly ($P \leq 0.05$) influenced change in soil population density of *P. brachyurus* compared to control. Percentage reduction in *P. brachyurus* population was significantly ($P \leq 0.05$) higher in plots amended with sunn hemp at 20 seedlings / plot than other amended plots and control. There was an increase in *P. brachyurus* population density in control plots and this was significantly ($P \leq 0.05$) higher than nematode population change in amended plots (Table 2).

Table 1: Effects of siam weed and sunn hemp amendments on percentage change in soil population density of *Pratylenchus brachyurus* in maize under field conditions

Treatment	First trial			Second trial		
	TZ-B-ELD-CS	TZ-DMRESR	LSD (0.05)	TZ-B-ELD-CS	TZ-DMRESR	LSD (0.05)
Siam weed at 20 seedlings/plot	3.83 (-46.26)	3.86 (-47.59)	0.09	3.85 (-47.20)	3.87 (-48.05)	0.10
Sunn hemp at 20 seedlings/plot	4.20 (-66.55)	4.14 (-62.97)	0.07	4.19 (-65.99)	4.17 (-64.82)	0.05
Siam weed at 10 seedlings/plot	3.71 (-41.03)	3.71 (-41.01)	0.16	3.69 (-40.14)	3.63 (-37.91)	0.39
Sunn hemp at 10 seedlings/plot	3.99 (-53.80)	4.02 (-56.00)	0.08	3.99 (-53.80)	4.04(-56.69)	0.06
Control (No amendment)	3.49 (+33.11)	3.68 (+40.91)	0.73	3.34 (+33.63)	3.38 (+31.54)	1.29
LSD (0.05)	0.15	0.20		0.56	0.32	

+ = percent increase in *P*ratylenchus *brachyurus* population. - = percent reduction in *P. brachyurus* population. Each value is the mean of four replicates. Analysis of variance is based on logarithm transformed data. Figures in parenthesis are means of original values. Initial population density (P_i) of *P. brachyurus* per plot = 415-490 J_2 / 200 ml soil.

Table 2: Effects of siam weed and sunn hemp amendments on percentage change in soil population density of *Pratylenchus brachyurus* infecting sorghum under field conditions

Treatment	First trial			Second trial		
	SK5192	CSR-01	LSD (0.05)	SK5192	CSR-01	LSD (0.05)
Siam weed at 20 seedlings/plot	3.97 (-53.17)	3.78(-43.98)	0.16	4.13 (-62.39)	4.20(-66.76)	0.15
Sunn hemp at 20 seedlings/plot	4.32 (-74.88)	4.12(-61.52)	0.06)	4.33 (-75.63)	4.17 (-64.82)	0.13
Siam weed at 10 seedlings/plot	3.80 (-44.91)	3.59 (-36.19)	0.17	3.72 (-41.41)	3.50 (-33.23)	0.12
Sunn hemp at 10 seedlings/plot	4.14(-62.89)	3.98 (-53.69)	0.03	3.99 (-53.92)	4.00(-54.61)	0.17
Control (No amendment)	2.48 (+13.77)	3.07(+22.55)	0.73	3.01 (+21.27)	3.08 (+22.52)	0.98
LSD (P = 0.05)	0.48	0.25		0.28	0.22	

+ = percent increase in *P*ratylenchus *brachyurus* population. - = percent reduction in *P. brachyurus* population. Each value is the mean of four replicates. Analysis of variance is based on logarithm transformed data. Figures in parenthesis are means of original values. Initial population density (P_i) of *P. brachyurus* per plot = 400-455 J_2 / 200 ml soil.

Table 3: Effects of siam weed and sunn hemp amendments on grain yield (t/ha) of *Pratylenchus brachyurus*-infected maize under field conditions

Treatment	First trial			Second trial		
	TZ-B-ELD-CS	TZ-DMRESR	LSD (0.05)	TZ-B-ELD-CS	TZ-DMRESR	LSD (0.05)
Siam weed at 20 seedlings/plot	0.84	1.00	0.36	1.60	1.36	1.28
Sunn hemp at 20 seedlings/plot	2.58	1.68	3.09	1.80	2.09	1.07
Siam weed at 10 seedlings/plot	0.51	0.61	0.11	1.07	0.84	0.31
Sunn hemp at 10 seedlings/plot	1.19	1.78	1.76	1.49	1.78	0.53
Control (No amendment)	0.32	0.26	0.09	0.49	0.52	0.42
LSD (0.05)	0.83	1.38		0.51	0.60	

Each value is the mean of four replicates

Sunn hemp incorporation into soil at the two rates (10 and 20 seedlings/plot) resulted in a significantly ($P \leq 0.05$) higher grain yield of maize than the control for both cultivars of maize evaluated (Table 2). Furthermore, sunn hemp incorporated at 20 seedling/plot produced a significantly ($P \leq 0.05$) higher grain yield of maize than 10 seedlings/plot in the first trial (Table 3). In the second trial, except plot amended with siam weed at 10 seedlings / plot which produced grain yield that was not different from yield in control plots, grain yield in all amended plots was significantly ($P \leq 0.05$) higher than that in control plots (Table 3). With respect to grain yield, the two cultivars of maize were not different in their response to sunn hemp and siam weed amendments in both trials (Table 3).

Incorporation of sunn hemp into soil planted to sorghum at 20 seedlings per plot resulted in the highest grain yield which was significantly higher than grain yield in other amended plots (Table 4). Control plots recorded a significantly ($P \leq 0.05$) lower grain yield of sorghum than plots amended with sunn hemp or siam weed. Twenty seedlings per plot of siam weed and sunn hemp amendment produced significantly ($P \leq 0.05$) higher grain yield than ten seedlings in the two cultivars of sorghum in both trials (Table 4).

Table 4: Effects of siam weed and sunn hemp amendments on grain weight (t / ha) of *Pratylenchus brachyurus*–infected sorghum under field conditions

Treatment	First trial			Second trial		
	SK5192	CSR-01	LSD (0.05)	SK5192	CSR-01	LSD (0.05)
Siam weed at 20 seedlings/plot	0.26	0.37	0.05	0.36	0.27	0.04
Sunn hemp at 20 seedlings/plot	0.43	0.50	0.29	0.40	0.47	0.30
Siam weed at 10 seedlings/plot	0.15	0.18	0.09	0.16	0.13	0.05
Sunn hemp at 10 seedlings/plot	0.29	0.29	0.09	0.31	0.19	0.11
Control (No amendment)	0.05	0.05	0.03	0.04	0.08	0.03
LSD (P = 0.05)	0.10	0.10		0.06	0.10	

Each value is the mean of four replicates

Table 5: Chemical properties of soil planted to maize before planting and at harvest

Treatment	Time of sampling	pH	Total N[%(w/w)]	Available P (mg kg^{-1})	Exch. K (cmol kg-^{1})
Siam weed at 20 seedlings/plot	Before planting	4.58± 0.15	0.50± 0.23	6.75±1.97	0.19±0.02
Sunn hemp at 20 seedlings/plot	At harvest	4.40± 0.14	0.99± 0.72	45.73±4.57	0.24±0.03
	Before planting	4.73± 0.10	0.63± 0.06	7.10±0.75	0.18±0.04
Siam weed at 10 seedlings/plot	At harvest	4.28± 0.24	0.70± 0.42	41.28±3.93	0.23±0.04
	Before planting	4.65± 0.19	0.54± 0.16	7.06±1.52	0.19±0.02
Sunn hemp at 10 seedlings/plot	At harvest	4.38± 0.17	0.64± 0.04	31.85±4.69	0.24±0.04
	Before planting	4.63± 0.19	0.54± 0.06	8.45±1.58	0.18±0.02
Control (No amendment)	At harvest	4.28± 0.24	0.70± 0.24	43.51±4.77	0.22±0.03
	Before planting	4.45± 0.24	0.75± 0.02	7.76±1.42	0.25±0.02
	At harvest	4.08± 0.22	0.47± 0.02	28.61±17.44	0.100.03
	LSD (0.05)	0.31	0.09	4.39	0.03

Each value is the mean ±standard deviation of four replicates, N = nitrogen, P = phosphorous, K= potassium. Exch., exchangeable.

Table 6: Chemical properties of soil planted to sorghum before planting and at harvest

Treatment		pH	Total N[%(w/w)]	Available P (mg kg^{-1})	Exch. K (cmol kg^{1}-)
Siam weed at 20 seedlings/plot	Before planting	4.70± 0.23	0.50±0.14	34.01± 5.85	0.19±0.02
Sunn hemp at 20 seedlings/plot	At harvest	4.25± 0.13	0.71±0.05	44.66± 7.40	0.29±0.02
	Before planting	4.63± 0.15	7.97±14.95	34.77± 3.22	0.19±0.02
Siam weed at 10 seedlings/plot	At harvest	4.25± 0.10	0.71±0.07	53.57± 10.54	0.25±0.03
	Before planting	4.63± 0.21	0.54±0.14	34.61± 8.30	0.22±0.05
Sunn hemp at 10 seedlings/plot	At harvest	4.30± 0.08	0.76±0.03	50.84± 12.47	0.29±0.04
	Before planting	4.60± 0.15	0.63±0.24	36.16± 3.19	0.23±0.06
Control (No amendment)	At harvest	4.30± 0.10	0.71±0.08	52.45± 7.31	0.33±0.07
	Before planting	4.60± 0.15	0.61±0.12	37.18± 8.30	0.25±0.08
	At harvest	4.10± 0.08	0.30±0.07	25.84± 12.47	0.15±0.05
	LSD (0.05)	0.32	0.09	6.03	0.05

Each value is the mean±standard deviation of four replicates, N = nitrogen, P = phosphorous, K= potassium. Exch., exchangeable.

The soil was slightly acidic before planting maize, while total N, available P and exchangeable K were moderate. Total N, available P and exchangeable K were significantly ($P \leq 0.05$) higher while pH was significantly ($P \leq 0.05$) lower in plots amended with sunn hemp and siam weed compared to the control plots at the time of harvest in both trials (Table 5). The trend in soil chemical properties in sorghum experiment (Tables 6) was similar to the trend in soil chemical properties in maize experiment.

DISCUSSION

Pre-planting and incorporation of siam weed and sunn hemp each at 10 and 20 seedlings / plot (22,220 seedlings / ha and 44,440 seedling / ha respectively) in *P. brachyurus* infested soil sown to maize and sorghum reduced the population density of *P. brachyurus* and increased yields of maize and sorghum. Higher grain yields obtained in plots incorporated with siam weed and sunn hemp seedlings may be due to improved soil conditions associated with the amendments, nemato-toxic substances released by the amendments and increased biological activities on decomposition of the amendments (Reeves, 1994; Adekunle, 2011). Green manure have been reported to affect soil physical properties due to the production of biomass which serve as a source of organic matter and substrate for soil biological activities (Bruce *et al*., 1991).

Sunn hemp is a leguminous plant which possesses efficient green manure properties including the ability to fix nitrogen. The plant is also rich in nematicidal compounds including monocrotaline which have been reported to kill several species of plant-parasitic nematodes (Rotar and Joy, 1983; McSorley *et al*., 1999; Wang *et al*., 2001). Siam weed has been reported to contain 1, 2 dehydropyrrolizidine alkaloids (PAs). This compound represents a class of secondary plant compounds that are active in defense against plant parasites, including plant-parasitic nematodes (Hartman, 1999; Thoden *et al*., 2007). *In vivo* study has shown that pure PAs from siam weed roots have nematicidal effects on root-knot nematode, *M. incognita* (Thoden *et al*., 2007).

The findings of this study agree with those of Adekunle (2011) who reported that field incorporation of sunn hemp and African marigold plants each at 10 and 20 plants/plot significantly reduced the population of *M. incognita* with corresponding increase in grain yields of cowpea and soybean. The plots amended with sunn hemp or African marigold at 20,000 seedlings /ha were significantly higher in grain yield than those amended with sunn hemp or African marigold at 10,000 seedlings/ha and where there was no amendment. Similarly Potter *et al*. (1999) reported that incorporation of *Brassica* leaf and root tissues into soil infested with *P. neglectus* resulted in a significant reduction in nematode populations in comparison with soil amended with wheat tissues and where there was no amendment. The use of siam weed as soil amendments is limited, however recent studies have shown that, incorporation of siam weed or African marigold seedlings each at the rate of 16 seedlings / plot as soil amendment, significantly suppressed the populations of *M. incognita, Dolichodorus* spp. and *Helicotylenchus* spp. and increased the leaf yields of *Amaranthus* spp. and *Telfairia* spp. in two field trials (Ogundele *et al*., 2015). *In vivo* studies demonstrate that mulch or aqueous crude extracts from siam weed roots reduced *M. incognita* infection on lettuce (Thoden *et al*., 2007).

In this study, plots amended with sunn hemp or siam weed at 20 seedlings/plot had significantly higher concentrations of nitrogen, phosphorous and potassium levels, and lower pH values in comparison to plots amended with 10 seedlings/plot and were there was no amendments. A number of studies using plant residues as soil organic amendments also demonstrated improved soil fertility following application of plant materials to the soil, either as mulches or as soil amendments (Reeves, 1994; Adekunle, 2011; Amulu and Adekunle, 2015; Ogundele *et al*., 2016).

Maize cultivars, TZ-B-ELD-CS and TZ-DMRESR were not different in their response to sunn hemp and siam weed amendments with respect to change in *P. brachyurus* population density and grain yield of maize. More nematodes were associated with CSR-01 than SK5192 cultivars of sorghum. However, the two cultivars responded the same way to amendment treatments in terms of yield.

In this study, siam weed and sunn hemp amendments were found effective in the management of *P. brachyurus* infecting maize and sorghum. However, the use of organic amendments is not likely to completely replace the use of synthetic nematicides for nematode control given the large quantities of organic amendments that are needed for effective management of plant parasitic nematodes. It should therefore be advocated that siam weed and sunn hemp as organic amendments could be used along with other effective methods in an Integrated Pest Management (IPM) programme. With this kind of arrangement, plant parasitic nematodes can be managed in a safe and sustainable manner.

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REFERENCES

Adekunle, O. K., 2011. Amendment of soil with African marigold and sunn hemp for management of *Meloidogyne incognita* in selected legumes. *Crop Protection,* **30**, 1392-1395.

Adekunle, O. K. and Fawole, B. 2003. Comparison of effects of extract of siam weed, neem and carbofuran on generation time and reproduction of *Meloidogyne incognita* Race 2 on tomato'. *Environmental and Ecology,* **21 (3),** 720-726.

Amulu, L. U. and Adekunle, O. K. 2015. Comparative effects of weathered poultry-manure, cow dung and carbofuran on *Meloidogyne incognita* infected Okra. *Journal of Agricultural Science and Technology*, **17**, 495-504.

Bremner, J. M. 1996. Total nitrogen. In: methods of soil analysis: chemical methods. Part 3 (Sparks, D. L., editor). Soil Science Society of America and the American Society of Agronomy Madison, WI, USA. 1123-1184.

Bruce, R. R., Hendrix, P. F. and Langdale, G. W. 1991. Role of cover crops in recovery and maintenance of soil productivity. P. 109-115 In: Hargrove WL editor. cover crops for clean water Proceedings of an International Conference, April 9-11, 1991. Jackson TN Soil and Water Conservation Society; Ankeny, U.S.A.

Castillo, P. and Vovlas, N. 2007. *Pratylenchus* (Nematoda: Pratylenchidae): dagnosis, biology, pathogenicity and management. In: Hun DJ, Perry RN editors. Nematology Monographs and Perspectives Vol. 6 Brill Leiden-Boston.

Charchar, J. M. and Huang, C. S. 1981. Host range of *Pratylenchus brachyurus* 3: Different species. *Fitopatology Brasilaire* **6**, 469-474.

Coyne, D. L., Hunt, D. J., Plowright, R. A. and Darboe, M. L. K. 2009. Further observations on nematodes associated with rice in Cote d' Ivoire, The Gambia, Guinea and Togo. *International Journal of Nematology,* **10**, 123-130.

Egunjobi, O. A. and Larinde, M. A. 1975. Nematodes and corn growth in Nigeria. II. effects of some amendments on populations of *Pratylenchus brachyurus* and on the growth and production of corn

(*Zea mays*) in Nigeria. *Nematology Mediterranean*, **3,** 65-74.

Hartmann, T. 1999. Chemical ecology of pyrrolizidine alkaloids. *Planta Horticulturae,* **207**, 483-495.

Kuo, S. 1996. Phosphorus. In: Methods of soil analysis: chemical methods part 3. (Sparks D L editor. Soil Science Society of America and the American Society of Agronomy Madison, WI, USA. 869-920.

Izuogu, N. B. and Oyedunmade, E. E. A. 2009. Pathogenicity and control of the root-knot nematode, *Meloidogyne incognita* on fluted pumpkin, *Telfairia occidentalis*. *Journal of Agricultural Resources and Development*, **7** and **8**, 61-71.

Mai, W. F. and Lyon, H. H. 1975. Pictorial key to Genera of plant-parasitic nematodes. Department of pPlant Pathology, New York State College of Agriculture, Cornell University, New-York. pp 44a-44e.

Marshall, A. J. 2002. Sunn hemp (*Crotalaria juncea*) as an organic amendment in Crop Production. M. Sc. Thesis, University of Florida, Gainesville, FL.

McSorley, R., Ozores-Hampton M., Stanley, P. A. and Conner, J. M. 1999. Nematode management, soil fertility and yield in organic vegetable production. *Nematropica,* **29,** 205-213.

Ogundele, R. A., Oyedele, D. J. and Adekunle, O. K. 2016. Management of *Meloidogyne incognita* and other Phytonematodes infecting *Amaranthus cruentus* and *Telfairia occidentalis* with African marigold and Siam weed. *Australasian Plant Pathology*, **45,** 537-545.

Onifade, A. K. and Egunjobi, O. A. 1996. Response of *Sorghum bicolor* to different population densities of *Pratylenchus zeae*. *Global Journal of Pure and Applied Science,* **2,** 23-27.

Oyedunmade, E. E. and Fatoki, O. K. 2000. Efficacy of *Chromolaena odorata* (siam weed) leaf treatment in the control of root-knot nematodes (*Meloidogyne* species) in soil sown to soybeans. *Bioscience Research Communications*, **13 (3)**, 307-310.

Potter, M. J., Vanstone, V. A., Davies, K. A., Kirkgaard, J. A. and Rathjen, A. J. 1999. Reduced susceptibility of *Brassica napus* to *Pratylenchus neglectus* in Plants with elevated root levels of 2-Phenylethyl Glucosinolate *Journal of Nematology*, **31**, 291–298.

Ravichandra, N. G. 2013. Fundamentals of Plant Pathology. PHI Learning Private Limited. New-Delhi, India. 450 pp.

Reeves, D. W. 1994. Advances in soil science. Crop residues management. Lewis Publishers London. pp 138-157.

Rotar, P. P. and Joy, R. 1983. 'Tropic Sun' sunn hemp, *Crotalaria juncea* L. Research Extension Series 036. College of Tropical Agriculture and Human Resources, University of Hawaii. 7 pp.

Sasser, J. N. and Freckman, D. W. 1987. A world perspective on nematology: The role of the Society. In: Veech, J.A., Dickson, D.W. (Eds). *Vistas on nematology*. Hyattsville, MD, USA, Society of Nematologists, pp. 7-14.

SAS Institute Inc. 2002. SAS / Stat User's Guide: Version 6.12, 4th Edn. SAS institute, Cary, NC.

Siji, J. V., Jayaprakas, C. A. and Sheela, M. S. 2010. Efficacy of *Cleome viscosa* L. against *Meloidogyne incognita* infestation on okra. *Thai Journal of Agricultural Science,* **43,** 151-156.

Sikora, R. A. and Fernandez, E. 2005. Nematode parasites of vegetables. In: Luc M, Sikora RA, Bridge J editors. Plant-parasitic nematodes in tropical and subtropical Agriculture, Wallingford, UK: CAB International, pp. 319-392.

Thoden, T. C., Boppre, M. and Hallmans, J. 2007. Pyrrolizidine alkaloids of *Chromolaena odorata* act as nematicidal agents and reduce infection of lettuce roots by *Meloidogyne incognita*. *Nematology*, **9**, 343-349.

Thomas, G. W. 1996. Soil pH and soil acidity. In: methods of soil analysis: chemical methods part 3. Sparks DL editor. Soil Science Society of America and the American Society of Agronomy Madison, WI, USA. 475-490.

Wang, K. H., Sipes, B. S. and Schmitt D. P. 2001. Suppression of *Rotylenchulus reniformis* by *Crotalaria juncea*, *Brassica napus* and *Tagetes erecta*. *Nematropica* **31**, 237-251.

Wang, K. H., Sipes, B. S. and Schmitt, D. P. 2002. *Crotalaria* as a cover crop for nematode management: a review. *Nematropica,* **32,** 35-57.

Windham, G. L. 1998. Maize. In: Barker KR, Pederson GA, Windham G.L. editors. Plant and nematode interactions. Madison, WI, USA, American Society of Agronomy, Inc., Crop Science Society of America, Inc., Soil Science Society of America, Inc., pp. 335-357.

Whitehead, A. G. and Hemming, J. 1965. A comparison of quantitative methods of extracting small vermiform nematodes from Soil. *Annals of Applied Biology,* **55**, 25-38.

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